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10/566,686	03/08/2007	Jifeng Liu	MIT-166	9220

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EXAMINER	
LANGMAN, JONATHAN C	
ART UNIT	PAPER NUMBER
1784	

NOTIFICATION DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/566,686	LIU ET AL.	
	Examiner	Art Unit	
	JONATHAN C. LANGMAN	1794	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *8/14/2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-4,6,8-10,12,14-16,18-22 and 24-33* is/are pending in the application.

4a) Of the above claim(s) *1-4,6,8-10,12,14 and 29-33* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *15,16,18-22 and 24-28* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *31 January 2006* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *1/31/2006, 10/03/2007 and 8/14/2008*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Restriction is required under 35 U.S.C. 121 and 372.

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1.

In accordance with 37 CFR 1.499, applicant is required, in reply to this action, to elect a single invention to which the claims must be restricted.

Group I, claim(s) 1-4, 6, 8-10, 12, 14, and 29-33, drawn to a method.

Group II, claim(s) 15, 16, 18-22, and 24-28, drawn to an article.

The inventions listed as Groups I and II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

(1) The common feature of a stress engineering layer and a germanium or SiGe layer upon a silicon substrate cannot qualify as a special technical feature as it does not provide a contribution over the prior art because it is disclosed by the prior art references (see the rejection set forth below).

In particular, Winnerl et al. teach a CoSi2-Si/SiGe Metal—semiconductor--metal (MSM) photodetectors. Therefore, the reference(s) specifically suggests using the common elements as claimed.

During a telephone conversation with Natasha Us on February 24, 2010 a provisional election was made with traverse to prosecute the invention of Group I,

claims 15, 16, 18-22 and 24-28. Affirmation of this election must be made by applicant in replying to this Office action. Claims 1-4, 6, 8-10, 12, 14, and 29-33 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

The examiner has required restriction between product and process claims. Where applicant elects claims directed to the product, and the product claims are subsequently found allowable, withdrawn process claims that depend from or otherwise require all the limitations of the allowable product claim will be considered for rejoinder. All claims directed to a nonelected process invention must require all the limitations of an allowable product claim for that process invention to be rejoined.

In the event of rejoinder, the requirement for restriction between the product claims and the rejoined process claims will be withdrawn, and the rejoined process claims will be fully examined for patentability in accordance with 37 CFR 1.104. Thus, to be allowable, the rejoined claims must meet all criteria for patentability including the requirements of 35 U.S.C. 101, 102, 103 and 112. Until all claims to the elected product are found allowable, an otherwise proper restriction requirement between product claims and process claims may be maintained. Withdrawn process claims that are not

commensurate in scope with an allowable product claim will not be rejoined. See MPEP § 821.04(b). Additionally, in order to retain the right to rejoinder in accordance with the above policy, applicant is advised that the process claims should be amended during prosecution to require the limitations of the product claims. **Failure to do so may result in a loss of the right to rejoinder**. Further, note that the prohibition against double patenting rejections of 35 U.S.C. 121 does not apply where the restriction requirement is withdrawn by the examiner before the patent issues. See MPEP § 804.01.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 15, 16, 18, 19, 27, and 28 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Winnerl et al. ("Fast IR Si/SiGe superlattice MSM photodetectors with buried $CoSi_2$ contacts").

Regarding claims 15, 16, and 18, Winnerl et al. teach a photodetector structure as seen in Figure 2 that comprises a bottom dark layer of $CoSi_2$, a 120 nm thick Si buffer layer (instantly claimed silicon substrate) directly thereon, and alternating superlattices of SiGe and Si represented by the thin alternating dark and light layers, deposited thereon (pgs 206-207).

Although Winnerl et al. do not teach that the $CoSi_2$ is a stress generating layer that increases the tensile strain of the SiGe layer, as instantly claimed, it is the examiners position that this instantly claimed property would be inherent to the structure of Winnerl et al. It has been held that where the claimed and prior art products are identical or substantially identical in structure or are produced by identical or a substantially identical processes, a prima facie case of either anticipation or obviousness will be considered to have been established over functional limitations that stem from the claimed structure. *In re Best*, 195 USPQ 430, 433 (CCPA 1977), *In re Spada,* 15 USPQ2d 1655, 1658 (Fed. Cir. 1990). The ***prima facie*** case can be rebutted by evidence showing that the prior art products do not necessarily posses the characteristics of the claimed products. *In re Best*, 195 USPQ 430, 433 (CCPA 1977). Since Winnerl et al. teach the same structure as instantly claimed, it is inherent that the CoSi2 layer is a stress generating layer that will impose some degree of tensile strain in the subsequently deposited SiGe layer.

Regarding claim 19, Winnerl et al. teach that the MSM detectors are capable for use at a wavelength of 1.55 microns (abstract). Although this wavelength is just outside the bottom range of the L-Band (i.e. 1.56 microns), it is the examiners position that L-Band photo detection to some degree will be seen in the SiGe layer. The applicant is not claiming a particular degree of L-Band photodetection, and therefore it is the examiners position that some degree of L-band detection (no matter how miniscule) of the SiGe layer will be imposed by the stress engineering layer. The examiners position

is further supported at least for the reasons mentioned above, wherein a structure and its properties are inseparable (See in re best case law).

Regarding claims 27 and 28, the instant claims set forth that the structure is a photodetector or an optical modulator and produced by the process set forth in claim 1. Winnerl et al. teach an optical modulator as well as a photodetector, and for reasons set forth above, also teach the product by process limitations set forth in instant claim 1. Therefore these claims are fully anticipated by the structure and process taught by Winnerl et al.

Claims 21, 22, 24, 25, 27, and 28 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Winnerl et al. ("MBE-growth of a Ge-CoSi2-Si heterostructures for vertical metal-semiconductor-metal photoconductors") (referred to herein as "Winnerl2").

Regarding claims 21, 22, and 24, Winnerl2 teach a photodetector structure that comprises a float zone silicon wafer, upon which is deposited a $CoSi_2$ layer. After annealing, a thin layer of amorphous Si was deposited, recrystallized and covered with a monolayer of Sb. A Ge layer was then deposited thereon (Pg 192, (section 2. Growth Process). Two scenarios of the structure of Winnerl2 are used to anticipate the claims as presented.

The first scenario being that the float zone silicon wafer reads on the instantly claimed silicon substrate. The applicant has not defined the relationship between the instantly claimed first and second surfaces of the silicon substrate. So that even

subsequently deposited layers of CoSi2 and Ge will read on the instantly claimed limitation, wherein the first surface is one part of the upper surface of the float zone silicon wafer, and the second surface is another part of the upper surface of the float zone silicon wafer.

The second scenario is that the recrystallized thin silicon layer is used to read on the instantly claimed silicon substrate; wherein the CoSi2 layer is formed underneath the Silicon layer, and the germanium layer is formed on an opposite surface of the silicon layer.

Although Winnerl2 do not teach that the $CoSi_2$ is a stress generating layer that increases the tensile strain of the Ge layer, as instantly claimed, it is the examiners position that this instantly claimed property would be inherent to the structure of Winnerl et al. It has been held that where the claimed and prior art products are identical or substantially identical in structure or are produced by identical or a substantially identical processes, a prima facie case of either anticipation or obviousness will be considered to have been established over functional limitations that stem from the claimed structure. *In re Best*, 195 USPQ 430, 433 (CCPA 1977), *In re Spada,* 15 USPQ2d 1655, 1658 (Fed. Cir. 1990). The ***prima facie*** case can be rebutted by evidence showing that the prior art products do not necessarily posses the characteristics of the claimed products. *In re Best*, 195 USPQ 430, 433 (CCPA 1977). Since Winnerl2 teach the same structure as instantly claimed, it is inherent that the CoSi2 layer is a stress generating layer that will impose some degree of tensile strain in the subsequently deposited Ge layer.

Regarding claim 19, Winnerl2 teach that the MSM detectors are capable for use at a wavelength of 1.55 microns (abstract). Although this wavelength is just outside the bottom range of the L-Band (i.e. 1.56 microns), it is the examiners position that L-Band photo detection to some degree will be seen in the Ge layer. The applicant is not claiming a particular degree of L-Band photodetection, and therefore it is the examiners position that some degree of L-band detection (no matter how miniscule) of the Ge layer will be imposed by the stress engineering layer. The examiners position is further supported at least for the reasons mentioned above, wherein a structure and its properties are inseparable (See in re best case law).

Regarding claims 27 and 28, the instant claims set forth that the structure is a photodetector or an optical modulator and produced by the process set forth in claim 1. Winnerl2. teach an optical modulator as well as a photodetector, and for reasons set forth above, also teach the product by process limitations set forth in instant claim 1. Therefore these claims are fully anticipated by the structure and process taught by Winnerl2.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 15, 16, 18, 19, 21, 22, 24, 25, 27, and 28 are rejected under 35 U.S.C. 103(a) as being obvious over Wada et al. (US 2003/0235931) in view of Cheng et al. ("Effects of Stress on the growth of TiSi2 thin films on (001)Si").

The applied reference has common inventors with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art only under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 103(a) might be overcome by: (1) a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not an invention "by another"; (2) a showing of a date of invention for the claimed subject matter of the application which corresponds to subject matter disclosed but not claimed in the reference, prior to the effective U.S. filing date of the reference under 37 CFR 1.131; or (3) an oath or declaration under 37 CFR 1.130 stating that the application and reference are currently owned by the same party and that the inventor named in the application is the prior inventor under 35 U.S.C. 104, together with a terminal disclaimer in accordance with 37 CFR 1.321(c). This rejection might also be overcome by showing that the reference is disqualified under 35 U.S.C. 103(c) as prior art in a rejection under 35 U.S.C. 103(a). See MPEP § 706.02(l)(1) and § 706.02(l)(2).

Regarding claims 15, 16, 18, 21, 22, 24, and 27, Wada et al. teach a photodetector device comprising a plurality of Ge or SiGe epilayers ([0019]) formed on a silicon substrate. Wada et al. teach that since the epilayers form a tensile strained Ge layer, the photodetector device can operate efficiently in the C-Band and the L-Band (abstract).

Wada is silent to the use of forming backside silicides or germanides in order to provide tensile strain in the Ge or SiGe epilayers. However Cheng et al. teach that CoSi2 backside layers are known in the art to provide tensile stress to silicon substrates for the deposition of a layer on the free surface thereof (abstract).

It would have been obvious to a routineer in the art to utilize backside silicidation techniques, as taught by Cheng, in order to provide tensile strained silicon substrates for the subsequent deposition of tensile strained Ge or SiGe epilayers, as Wada has recognized in the art that tensile stresses in Ge photodetectors formed on silicon substrates are desired and necessary to allow the photodetector device to operate in the C-Band and L-Band.

Regarding claims 19 and 25, the combination of Wada and Cheng teaches the same structure as instantly claimed. It has been held that where the claimed and prior art products are identical or substantially identical in structure or are produced by identical or a substantially identical processes, a prima facie case of either anticipation or obviousness will be considered to have been established over functional limitations that stem from the claimed structure. *In re Best*, 195 USPQ 430, 433 (CCPA 1977), *In re Spada,* 15 USPQ2d 1655, 1658 (Fed. Cir. 1990). The ***prima facie*** case can be rebutted by evidence showing that the prior art products do not necessarily posses the characteristics of the claimed products. *In re Best*, 195 USPQ 430, 433 (CCPA 1977). Since the combination of Wada and Cheng teaches the same structure as instantly claimed it is the examiners position that the instantly claimed feature of L-band photodetection of the Ge or SiGe layer would be inherent to the structure of Luan and

Cheng. Furthermore it is the examiners position that L-Band photo detection to some degree will be seen in the Ge or SiGe layer. The applicant is not claiming a particular degree of L-Band photodetection, and therefore it is the examiners position that some degree of L-band detection (no matter how miniscule) of the Ge or SiGe layer will be imposed by the stress engineering layer.

Regarding claims 27 and 28, the instant claims set forth that the structure is a photodetector or an optical modulator and produced by the process set forth in claim 1. The combination of Wada and Cheng teaches an optical modulator as well as a photodetector, and for reasons set forth above, also teach the product by process limitations set forth in instant claim 1. Therefore these claims are fully anticipated by the structure and process taught by the combination of Wada and Cheng.

Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Winnerl et al. ("Fast IR Si/SiGe superlattice MSM photodetectors with buried $CoSi_2$ contacts") as applied to claims 15, 16, 18, 19, 27, and 28 above in view of Gluck et al. ("$CoSi_2$ and $TiSi_2$ for Si/SiGe heterodevices").

Winnerl et al. teach MSM photodetectors that comprise Si/SiGe superlattices that utilize CoSi2 as contacts. Winnerl et al. fail to teach the use of c54-$TiSi_2$ contacts.

Gluck teach that C54 TiSi2 and Cosi2 are both suitable contacts for devices utilizing Si/SiGe heterojunctions (abstract and paragraph bridging pgs 552-553). It would have been obvious to a routineer in the art to utilize c54-TiSi2 in lieu of CoSi2, as

a suitable contact in the photodetector of Winnerl et al., as Gluck has shown that CoSi2, and TiSi2 contacts are both capable of serving that function and known in the art to be functionally equivalent, in that they provide adequate contact resistance to the desired device.

Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Winnerl2 ("MBE-growth of a Ge-CoSi2-Si heterostructures for vertical metal-semiconductor-metal photoconductors") as applied to claims 21, 22, 24, 25, 27, and 28 above, in view of Gluck et al. ("$CoSi_2$ and $TiSi_2$ for Si/SiGe heterodevices").

Winnerl2 teach photodetectors that comprise Si/Ge heterodevices that utilize CoSi2 contacts as described above. Winnerl2 fail to teach that c54 $TiSi_2$ is a suitable contact for the heterojunction photodetector.

Gluck teach that C54 TiSi2 and Cosi2 are both suitable contacts for devices utilizing Si/SiGe heterojunctions (abstract and paragraph bridging pgs 552-553). It would have been obvious to a routineer in the art to utilize c54-TiSi2 in lieu of CoSi2, as a suitable contact in the photodetector of Wnnerl2, as Gluck has shown that CoSi2, and TiSi2 contacts are both capable of serving that function and known in the art to be functionally equivalent, in that they provide adequate contact resistance to the desired device.

Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Winnerl et al. ("Fast IR Si/SiGe superlattice MSM photodetectors with buried $CoSi_2$ contacts") as applied to claims 15, 16, 18, 19, 27, and 28 above in view of Martin et al. (US 5541438).

Winnerl et al. teach the photodetector described above. Winnerl et al. fail to teach the use of a dielectric layer on top of the Photodetector.

Typical MSM photodetector construction is taught by Martin et al. Martin et al. teach a structure comprising a substrate, 100, semiconductor layers, 102, 103, and 105. As seen in figures 1d and 1E contacts 116 and 118 are formed thereon. Martin go on to teach that a protective or passivating layer are formed on these structures to provide chemical and physical isolation for the covered portions of Figure 1F. These passivation layers are taught to be made of SiO2 (a dielectric material).

It would have been obvious to a routineer in the art to combine these known constructions of photodetectors taught by Martin et al. with the MSM photodetector of Winnerl et al. as Martin has shown that passivating the top surface of the MSM photodetectors is known in the art and utilized to provide chemical and physical isolation of the MSM photodetector devices.

Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Winnerl2 ("MBE-growth of a Ge-CoSi2-Si heterostructures for vertical metal-semiconductor-metal photoconductors") as applied to claims 21, 22, 24, 25, 27, and 28 above, in view of Martin et al. (US 5541438).

Winnerl2 teach the photodetector described above. Winnerl2 fail to teach the use of a dielectric layer on top of the Photodetector.

Typical MSM photodetector construction is taught by Martin et al. Martin et al. teach a structure comprising a substrate, 100, semiconductor layers, 102, 103, and 105. As seen in figures 1d and 1E contacts 116 and 118 are formed thereon. Martin go on to teach that a protective or passivating layer are formed on these structures to provide chemical and physical isolation for the covered portions of Figure 1F. These passivation layers are taught to be made of SiO2 (a dielectric material).

It would have been obvious to a routineer in the art to combine these known constructions of photodetectors taught by Martin et al. with the MSM photodetector of Winnerl2 as Martin has shown that passivating the top surface of the MSM photodetectors is known in the art and utilized to provide chemical and physical isolation of the MSM photodetector devices.

Claims 20 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wada et al. (US 2003/0235931) in view of Cheng et al. (“Effects of Stress on the growth of TiSi2 thin films on (001)Si") as applied to claims 15, 16, 18, 19, 21, 22, 24, 25, 27, and 28 above in view of Martin et al. (US 5541438).

Luan and Cheng teach the photodetector described above. Luan and Cheng fail to teach the use of a dielectric layer on top of the Photodetector.

Typical MSM photodetector construction is taught by Martin et al. Martin et al. teach a structure comprising a substrate, 100, semiconductor layers, 102, 103, and 105. As seen in figures 1d and 1E., contacts 116 and 118 are formed thereon. Martin go on to teach that a protective or passivating layer is formed on these structures to provide chemical and physical isolation for the covered portions of Figure 1F. These passivation layers are taught to be made of SiO2 (a dielectric material).

It would have been obvious to a routineer in the art to combine these known constructions of photodetectors taught by Martin et al. with the MSM photodetector of Luan and Cheng, as Martin has shown that passivating the top surface of the MSM photodetectors is known in the art and utilized to provide chemical and physical isolation of the MSM photodetector devices.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The X references cited in the international search report for PCT/US2004/24747 are considered to be pertinent to the applicant's disclosure, however the references applied are considered to be more pertinent to the instant claims.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JONATHAN C. LANGMAN whose telephone number is

(571)272-4811. The examiner can normally be reached on Mon-Thurs 8:00 am - 6:30 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jennifer McNeil can be reached on 571-272-1540. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JCL

/Timothy M. Speer/
Primary Examiner, Art Unit 1794